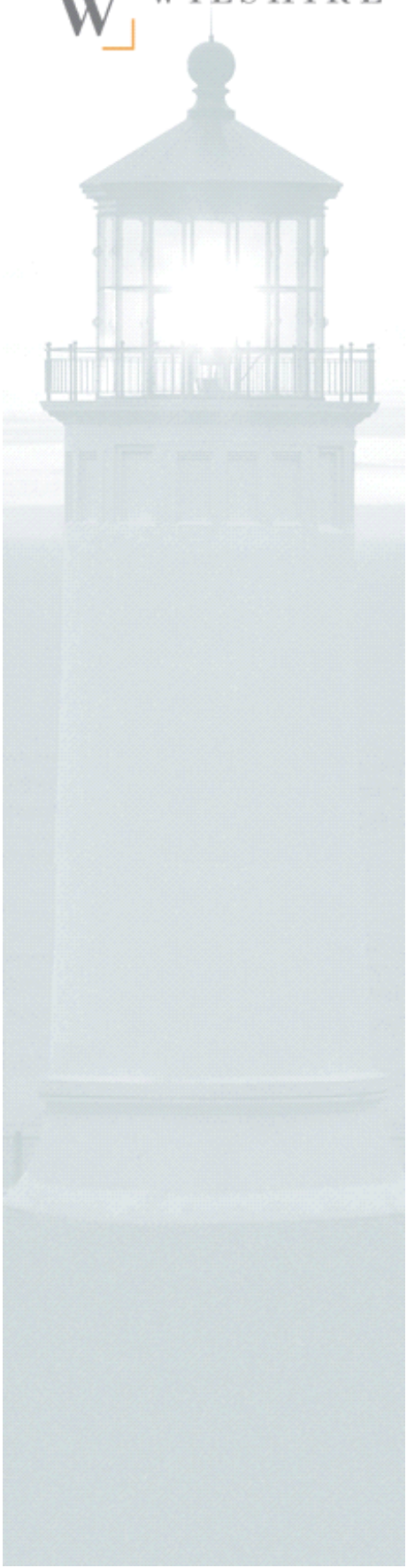

Wilshire Research

Commodity Futures Investing: Is All That Glitters Gold?

Steven J. Foresti
Thomas E. Toth
(310) 451-3051
sforesti@wilshire.com
ttoth@wilshire.com

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Introduction

The recent performance of commodities has thrust the asset class into the spotlight as investors continue to search for enhanced returns and portfolio diversification. In fact, over the last year, there has been a tremendous increase in the flow of funds to commodity index linked assets. For example, in the U.S. mutual fund sector, assets have grown from less than $300 million two years ago to almost $7.5 billion.[1]

Commodities have historically been viewed as a hedge against inflation, though recent research has focused more closely on the use of commodities as a tool for diversification. The low measured correlation of commodity returns with more traditional assets, such as stocks and bonds, stems from their price sensitivity to current economic supply and demand forces. In contrast, stock and bond valuations are more heavily driven by forward-looking expectations. This paper is composed of two sections. The first deals with commodity futures in isolation by laying out the components of commodity future returns, while the second section examines the historical risk and return characteristics of an equal-weighted commodity futures index and illustrates how an allocation to it can affect a portfolio of diversified assets.

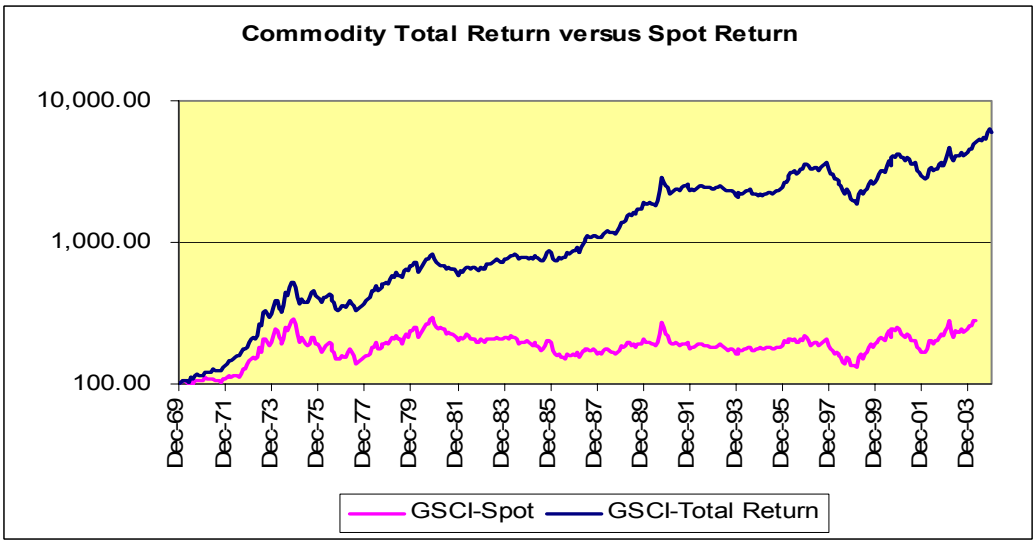
Commodity Futures

Institutional investors can gain exposure to commodities through the futures market. Investable commodity indices, constructed from a combination of commodity futures contracts, can provide investors broad access to the return and diversification attributes of underlying commodities. The returns for commodity futures differ from direct commodity ownership because commodity futures do not represent compensation for the risk associated with future cash flow uncertainty. Instead, investors in commodity futures are compensated for bearing the risk of short-term commodity price fluctuations. In other words, a majority of a commodity future investor's exposure is to short-term economic conditions, while forecasting plays a much smaller role than in the stock or bond markets.

Historically, commodity futures' returns have significantly outperformed investment in direct commodities. It is important to recognize the factors that drive commodity future returns to understand the relative performance difference evident in Exhibit 1.

[1] Barclays Capital

Exhibit 1: Commodity Futures Total Return vs. Spot Return



Source: Goldman Sachs Commodity Index Returns

Components of Return for Commodity Futures

- Insurance (Risk) Premium
- Collateral Yield
- Rebalancing Yield
- Convenience (Roll) Yield
- Expectational Variance

Insurance (Risk) Premium

The forces that drive futures prices vary based on the type of commodity. Some commodities, like precious metals, are investment assets, while most others, like oil, cattle and coffee beans, are consumption assets. Arbitrage forces precisely control the relationship between spot and futures prices for investment commodities, which are held by some solely for investment purposes. Futures prices for consumption commodities, on the other hand, are reduced by an implied premium paid by commodity producers.

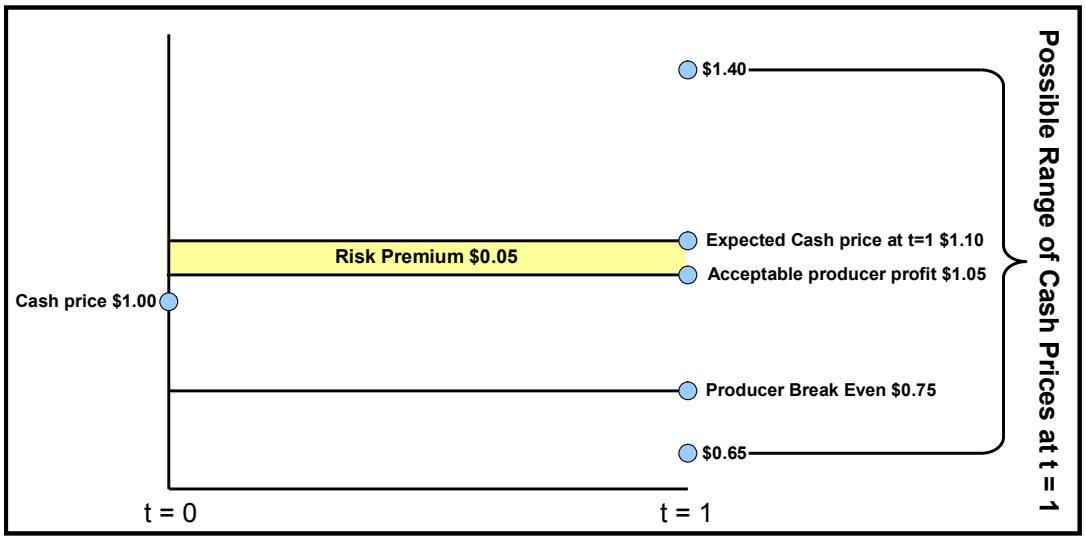
Commodity futures allow producers to separate their business risk from a commodity's price risk. The less commodity exposure a producer has, the more efficiently he/she is able to deploy capital for production and marketing, rather than using capital as a reserve to cushion against commodity price shocks.[2] For example, to protect against the business risk that would result from a steep decline in coffee bean prices, a coffee producer is willing to forfeit a portion of his/her expected profit by locking-in a price that is below the expected future spot price of coffee beans. The commodity futures investor collects this risk premium for accepting the commodity price risk. Producers of the underlying commodities are willing to pay this insurance premium because of the overwhelming

[2] Weiser, Stefan. The Strategic Case for Commodities in Portfolio Diversification. 2003

business risk associated with commodity prices. Commodity investors provide this assurance over a particular time horizon in exchange for an implicit risk premium. In other words, a long futures position is expected to earn positive excess returns as long as the futures price is set below the expected terminal spot price, even if commodity spot prices are expected to decline.

The hypothetical example in Exhibit 2 illustrates this graphically. At time t = 0, a producer expects his commodity to be $1.10 at time t =1, although it might range as high as $1.40 or as low as $0.65. To protect against the possibility of the price falling below the producer's breakeven point of $0.75, the producer is content to lock-in the $1.05 futures price. Commodity consumers are unwilling to take the other side of the transaction because locking-in their raw materials cost can increase their business risk, as they do not control the final price of their output. The commodity consumer is content to buy at market price, tack on a processor's margin, and ultimately pass the final price on to the customer (if you go to Starbucks you're familiar with this concept). In addition, investors are unwilling to accept the price uncertainty inherent in a futures contract without some type of compensation. In this case, the producer makes an acceptable profit by selling forward at $1.05 and the investor is compensated by a $0.05 risk premium for accepting the price uncertainty.

Exhibit 2: Commodity Futures Pricing Model



In Exhibit 2, the spot price would be $1.00 and the futures price would be $1.05, even though the expected future price is $1.10, to reflect the need to pay an insurance premium. It is important to note that this inherent return to commodity futures investments is unrelated to the underlying spot price movement. While the concept of a risk premium is theoretically sound, the statistical evidence to support and quantify a premium has been inconclusive. This issue will be revisited later in the report.

Collateral Yield

The mechanics of a futures contract allows an investor to obtain exposure to the price movements of an underlying asset without taking possession of the asset. And, except for creating and maintaining a margin account, there is no transfer of cash to initiate the investment. Since commodity futures positions are fully collateralized, investors retain the use of capital while gaining exposure to the underlying commodity's price movement. The return, or collateral yield, generated by this available capital is earned in addition to the return expectations from investing in commodity futures. Short-term Treasury bills typically characterize the collateral yield, although there is an opportunity to allocate the collateral to relatively more aggressive assets (i.e. longer duration bonds or TIPS). This would increase the overall expected return of the commodity futures allocation, but with a higher risk level.

Rebalancing Yield

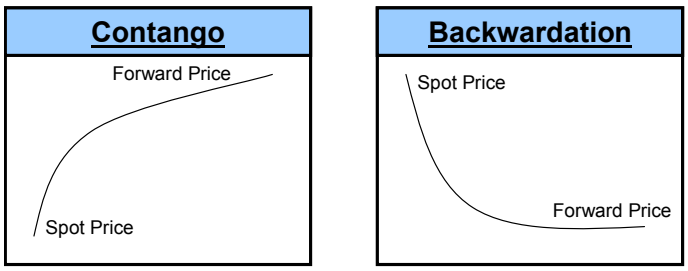
A commodity futures index can increase in value over time even if a number of the index components do not, as long as they do not rise and fall at the same time. Because many commodities exhibit mean reverting tendencies, the index returns can be enhanced by selling the commodities that rise and buying those that fall. This is known as rebalancing yield. This mean reversion is present because of the boom and bust nature of many commodities. For example, as the price of a commodity rises, new production is brought on-line. This new production can lead to an over supply and concomitant drop in price. Production is trimmed once it is unprofitable, reducing supply and increasing prices again before the cycle repeats.[3] An index methodology that periodically rebalances commodities based on predefined weighting rules can take advantage of these mean-reverting tendencies. In essence, the relative "winners" are sold and 'losers' are purchased in advance of their relative reversions. However, if futures prices trend up or down for an extended period of time, rebalancing will have a negative effect when compared to a buy-and-hold approach. Studies that have found a rebalancing yield suggest it may be between 1.5% and 2.75% depending on the original index weightings, how often rebalancing occurs and the cross-correlations between index commodities.[4,5]

Convenience Yield

Another component of return is known as a convenience yield. A commodity futures position is an investment in a futures contract that subsequently comes due. To maintain a long-term investment in a commodity, an existing contract's expiration necessitates rolling forward into a new futures contract. Also referred to as roll yield, the convenience yield results from the exploitation of commodity futures curves when they are in a condition known as "backwardation". Backwardation occurs when a commodity's spot price is higher than its futures price. In contrast, when the futures price is higher than the spot price the forward curve is said to be in "contango".

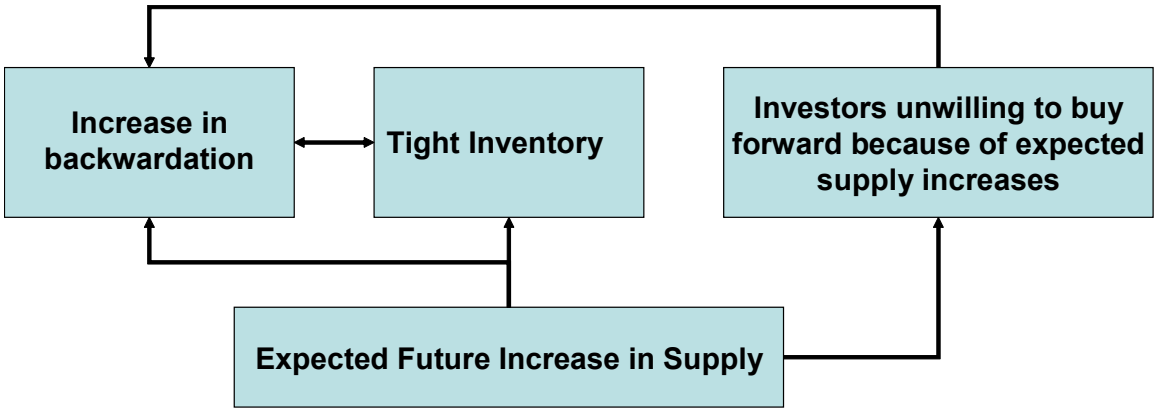
[3] De Chiara, Adam. The Benefits of Real Asset Portfolio Diversification. 2004.
[4] Greer, Robert. The Nature of Commodity Index Returns. 2003
[5] Erb, Claude B. The Tactical and Strategic Value of Commodity Futures. 2005

Exhibit 3: Forward Curves under Contango and Backwardation



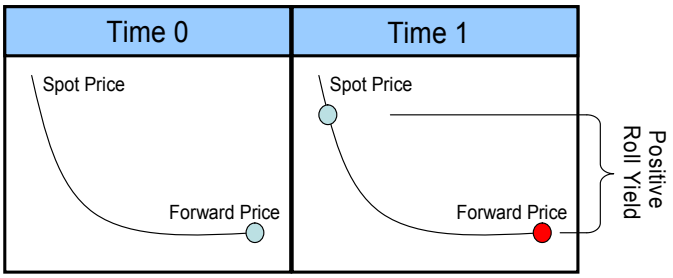
Futures curves become backwardated when a bump in demand for the physical commodity coincides with a shortage in inventory (which can occur for a number of reasons). Exhibit 4 illustrates a cycle for backwardation. With the tight inventory, demand for immediate supply increases and the premium that commodity users will pay goes up accordingly, increasing the amount of backwardation. If investors also perceive there will be a future increase in supply, they will be unwilling to buy forward contracts, hoping to buy cheaper in the future in the cash market. This allows inventory to remain tight and further increases the amount of backwardation.

Exhibit 4: Hypothetical Backwardation Cycle



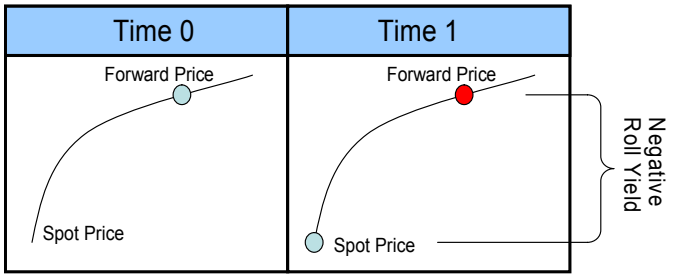
When the futures curve is backwardated there is an opportunity to enhance returns, called a convenience or roll yield. This is illustrated by the backwardated futures curve in Exhibit 5. At time 0, the futures contract represented by the light blue dot is purchased. At time 1, that futures contract has rolled up the futures curve as it nears expiration. The blue futures contract is sold and the new nearby futures contract (red dot) is purchased. A commodity index's returns are impacted positively as this cycle is repeated every month.

Exhibit 5: Backwardation and Convenience (Roll) Yield



In contrast, as illustrated in Exhibit 6, a contango futures curve provides negative roll yield. Here the first contract purchase moves down the forward curve toward expiration and negatively contributes to the commodity future's return.

Exhibit 6: Contango and Convenience (Roll) Yield



Gold, for example, is a commodity that uniformly exhibits a contango forward curve. Its ease of storability makes supply tightening seen in the energy markets rare, and therefore negates the justification for a convenience premium. In this case, the rolling of futures would contribute negatively to commodity futures' return.

The empirical evidence for a return premium from backwardation is mixed. Goldman Sachs has estimated roll yield at approximately 1.7% for the Goldman Sachs Commodity Index ("GSCI"). This would be driven by the large allocation to energy commodities within the index as energy commodities exhibit backwardation fairly consistently. An index with a lower energy weighting and higher gold weighting, for example, might exhibit a lower roll yield because gold tends to be in contango and contributes negatively to roll yield. In other research, Kolb concluded that normal backwardation did not exist for a cross section of commodities while Miffre, using different statistical techniques, concluded that there is evidence of normal backwardation and hence a return premium.[6,7]

Expectational Variance

A significant component of a commodity futures return is expectational variance, which is the difference between the *expected* spot price and the *actual* spot price at time t = 1. In

[6] Kolb, Robert W. Is Normal Backwardation Normal? Journal of Futures Markets, 1992
[7] Miffre, Joelle. Normal Backwardation is Normal. Journal of Futures Markets, 2000

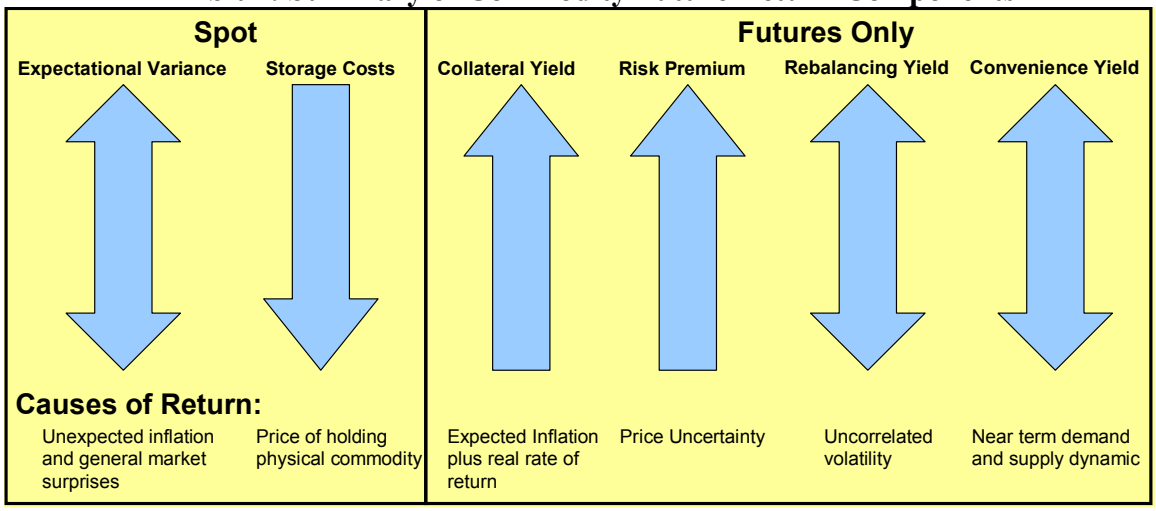
an efficient market, one would expect these variances to be up as often as down and therefore they are not considered an inherent return. Expectational variance includes changes in unexpected inflation for example, as well as changes in the underlying economics of each commodity as the futures contract approaches expiration.

Storage Costs

The storage costs on physical commodities can be thought of as negative income. This is particularly true for commodities such as gold which can be stored for an infinite period of time. On the other hand, storage costs do not play a large role for commodities used for consumption versus those used for investment (cattle vs. gold for instance). For consumption commodities, withholding them from the market and paying a storage cost is not an option and therefore storage costs are less relevant. This idea holds to a different degree for different commodity markets however.[8]

Exhibit 7 summarizes the components which comprise the total return earned on commodity investments. As was explained earlier, the majority of these components are independent of the underlying (spot) commodity and are reflective of supply/demand conditions and the general economic environment.

Exhibit 7: Summary of Commodity Future Return Components

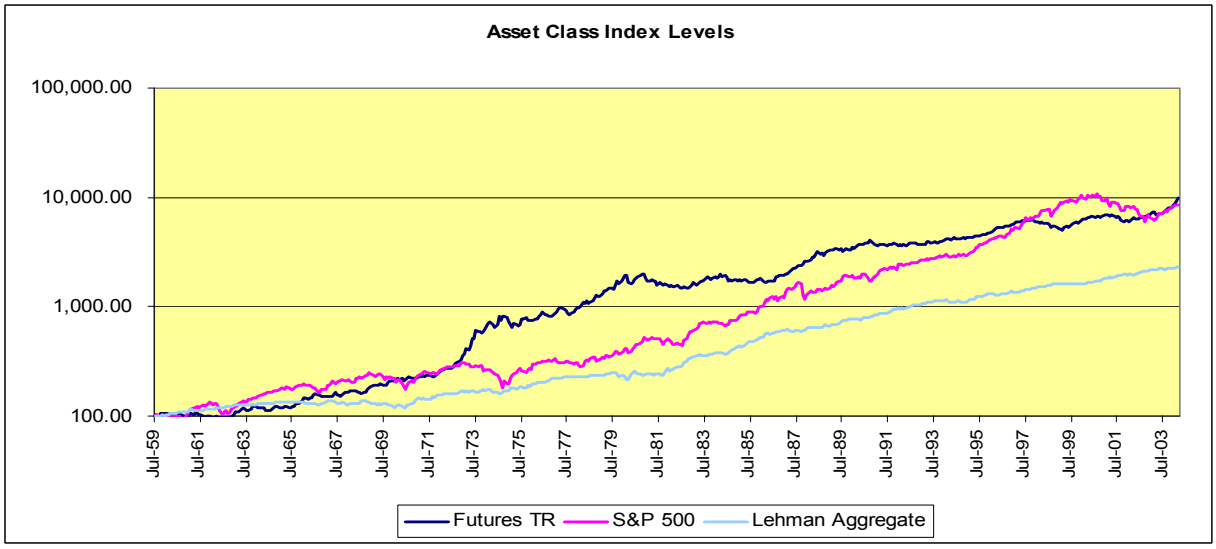


An equal-weighed index of commodity futures constructed by Gary Gorton of the University of Pennsylvania and K. Geert Rouwenhorst of Yale University is used throughout the paper to quantify the return/risk characteristics and long term risk premium for commodity futures. This index was chosen because it uses data from the Commodities Research Bureau and the London Metals Exchange going back to 1959, roughly 11 years longer than the next oldest commodity index. The equal-weighted index also covers 34 commodities, ranging from wheat, corn, and coffee to crude oil, unleaded gas, and gold. For a more complete discussion on the makeup of the index, please see Gorton and Rouwenhorst's "Facts and Fantasies about Commodity Futures"

[8] Greer, Robert. The Nature of Commodity Index Returns. Journal of Alternative Investments, 2000.

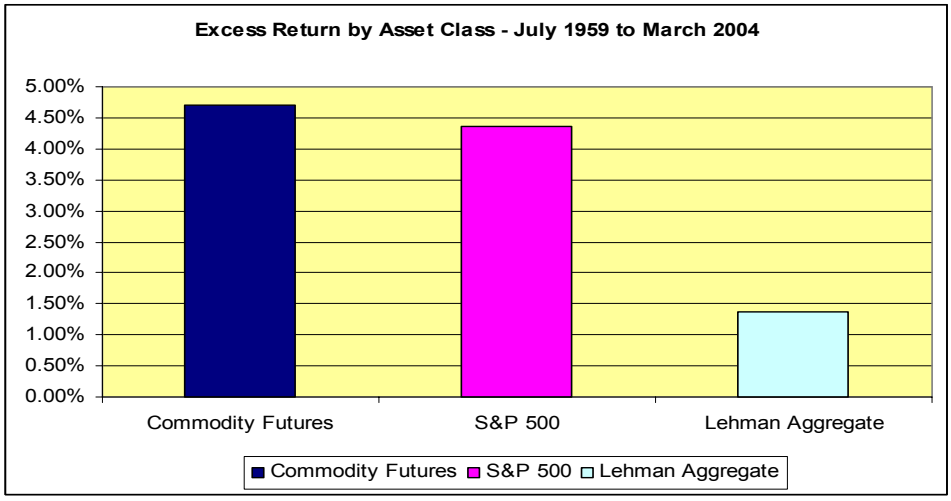
Appendix 1.[9] As Exhibit 8 demonstrates, commodity futures have a track record comparable to equities as measured by the S&P 500 and superior to bonds as measured by the Lehman Aggregate.

Exhibit 8: Commodity Index Levels versus Stocks and Bonds (log scale)



Using the same equal-weighted commodity futures index, excess returns can be calculated. Over the 1959 to 2004 time period, commodity futures provided an annual excess return of 4.71%, comparable to 4.37% for stocks.

Exhibit 9: Excess Returns



Source: Excess returns were calculated by taking the total monthly return minus the Treasury bill return, annualized.

[9] Gorton, Gary and Rouwenhorst, K. Geert. Facts and Fantasies about Commodity Futures. Yale ICF Working Paper No. 04-20, 2004.

While it might be possible to associate a portion of the roughly 5% historical excess return from commodity futures to a risk premium, a careful analysis suggests the excess return might be composed of other return drivers. The roll yield on the equal-weighted index is not broken out explicitly and it is possible that roll yield is slight for an index of this construction. While the GSCI's roll yield is estimated to be approximately 1.7%, it maintains a high concentration of energy commodities that are more likely to be backwardated and therefore provide positive roll yield. The equal-weighted index does not have this attribute.

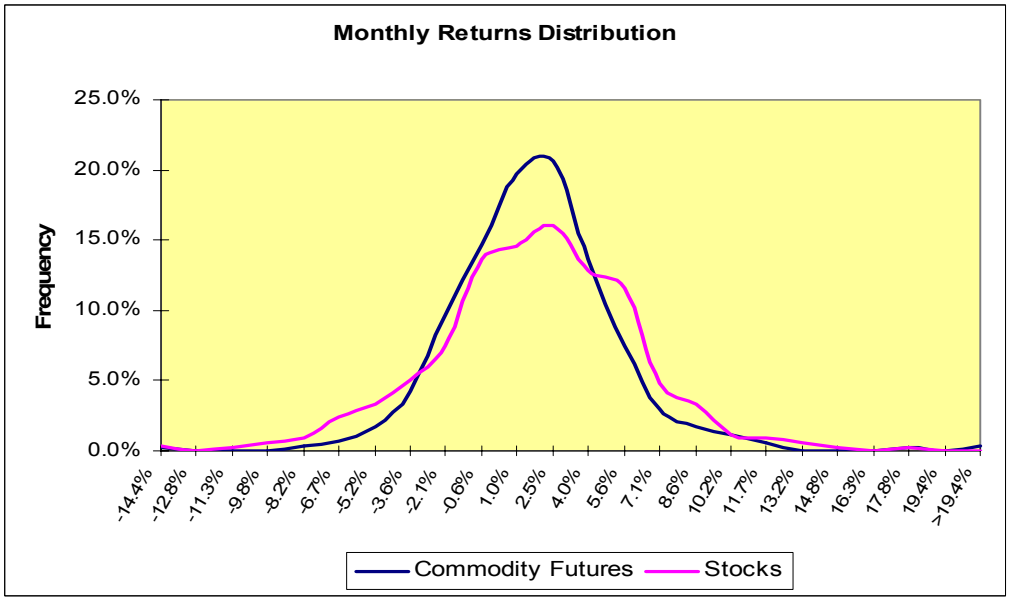
The rebalancing yield, however, might be a significant portion of that 4.71% excess return. Over the time period associated with the equal-weighted index, inflation ran at an average annualized monthly rate of 4.2%, while an equal-weighted spot index returned 8.7%.[10] Intuitively, one would expect the returns of the two to be much closer than that over such a long time period, so part of the 4.5% difference might be attributable to the index's monthly rebalancing. This complicates the argument for a risk premium further.

By observing risk over the same time period, commodity futures appeared less risky than stocks, with an annualized standard deviation of 12.12% versus 14.91% for the S&P 500. Taken together with the returns, the Sharpe Ratio (excess return divided by standard deviation) was higher for commodity futures (0.39) than for stocks (0.29).

The returns distribution in Exhibit 10 compares the monthly returns of the S&P 500 with Gorton's equal-weighted commodity futures index. On a monthly basis, commodity futures and stocks had about an equal average return of 0.92%; however stocks exhibited a higher monthly standard deviation of 4.3% versus 3.5% for commodity futures. Further, the distribution of stock returns exhibited negative skewness while commodity futures were positively skewed. This would indicate that equities had higher downside risk relative to commodities and, in fact, the minimum monthly return for equities in this period was -21.55% compared to -14.36% for commodity futures.

[10] Gorton, Gary and Rouwenhorst, K. Geert. Fact and Fantasies About Commodity Futures. 2004 p23.

Exhibit 10: Monthly Returns Distribution: Commodity Futures and Stocks



Empirically, commodity futures have historically performed significantly better when other assets, like stocks and bonds, falter most. In months when the S&P 500 returned -5% or less, the average monthly commodity futures' return was 0.25%; and in months when the S&P 500 returned less than -10%, commodity futures performed much better at 2.33%. A similar picture emerges when comparing bonds with commodity futures. When bonds, as measured by the Lehman Aggregate, returned less than -2% in a month, commodity futures returned an average of 1.83%. While it is important to recognize that the number of observations for stock and bond returns of this magnitude is small, the pattern of commodity futures out-performance is noteworthy. One possible explanation for these phenomena is that, unlike stocks and bonds, many participants are locked into the commodities market for business reasons which might isolate commodities from the more extreme price movements.

Commodity Futures within a Diversified Portfolio

While it appears that commodity futures provided attractive returns relative to risk, it is even more important to study their diversification effects within a portfolio of assets. As discussed earlier, commodity futures are more sensitive to short term economic conditions than are equities or bonds. In this way, one might expect that commodity futures will perform differently when short and long-term expectations differ. Exhibit 11 supports this as commodity futures exhibited negative correlation to both equities (-.14) and bonds (-.32).

Exhibit 11: Annual Correlations between Asset Classes and Inflation 1959 - 2004

	Commodity Futures	S&P 500	Lehman Aggregate	Inflation
Commodity Futures	1.00	(0.14)	(0.32)	0.34
S&P 500		1.00	0.31	(0.20)
Lehman Aggregate			1.00	(0.20)
Inflation				1.00

This low correlation implies that commodity futures might play a useful role in diversifying institutional portfolios. It should also be noted that commodity futures are positively correlated with short-term inflation whereas both equities and bonds are negatively correlated. Based on this relationship, commodity futures appear useful as a hedge against short-term inflation.

An analysis of commodity stock returns suggests that a similar hedge against inflation can be produced with a portfolio of stocks of commodity producing companies, such as oil or mining companies. We constructed a portfolio of energy and metal companies from the Dow Jones Wilshire 5000 and found their correlation with inflation to be similar to that of commodity futures over the 1978 to 2004 time period. If investor interest in commodities revolves solely around hedging out inflation risk, a concentrated position in commodity stocks might make sense. However commodity stocks exhibited substantially higher correlations to the overall equity market which suggests that commodity stocks do not provide the same level of portfolio diversification as do commodity futures.

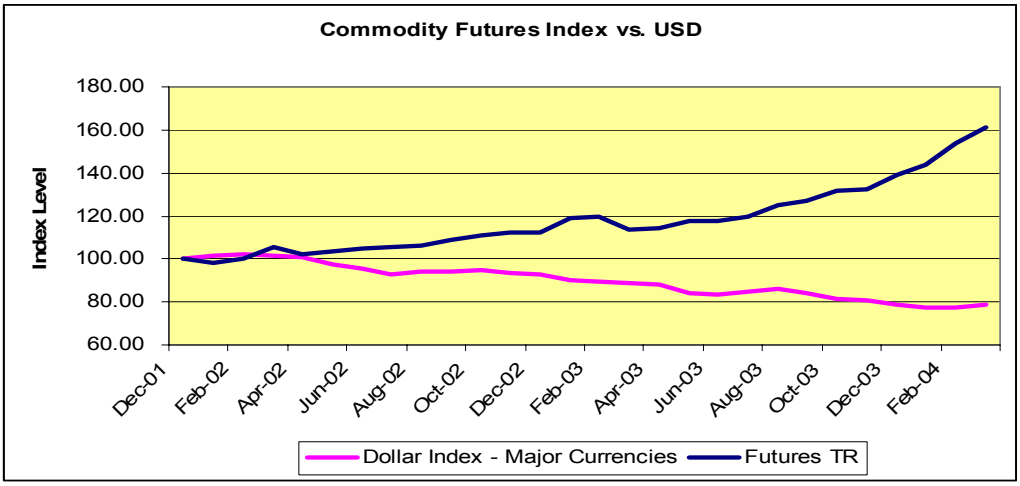
Gorton also examined the argument that investing in commodity stocks (oil producers and mining companies for instance) can act as a substitute for commodity futures investing. There is a significant difference between the returns on an index of commodity stocks and returns of the equal-weighted commodity futures index. In fact, from 1962 to 2003, a commodity futures index returned three times that of commodity stocks. In addition, the average monthly correlation between the two is 0.38, which suggests the two are not close proxies for each other.[11]

The reasons commodity futures exhibit a negative correlation to other asset classes are discussed below. Commodity futures have historically been negatively correlated to the U.S. dollar. An equal-weighted commodity futures index exhibits an annual correlation of -.11, implying that a falling dollar has been a positive for commodity futures and vice versa. For comparison, the S&P 500 has almost no correlation to the dollar (.02) and the Lehman Aggregate is also negative on an annual basis at -.08.

This negative correlation makes sense because when the dollar is falling in value U.S. investors are more likely to increase their demand for hard assets, causing prices to rise. Recent history supports this assertion as well. Exhibit 12 illustrates the return history since the U.S. dollar began its slide in 2002.

[11] Gorton, Gary and Rouwenhorst, K. Geert. Facts and Fantasies about Commodity Futures. 2004 p29-30.

Exhibit 12: Equal-Weighted Commodity Futures Index versus the U.S. Dollar



Finally, recent research illustrates that commodities fluctuate with the business cycle, performing well in the late stages of an economic expansion when stocks tend to fall and doing relatively worse late in recessions when stocks tend to take off. Gorton reports that from 1959 to 2004, over a period of seven full business cycles, commodity futures returned 3.5% during early recession phases while stocks and bonds return -15.5% and -2.9% respectively.[12] This makes sense because of the short term nature of commodity futures. For example, prior to the peak of a business cycle, the demand for commodities is high and commodities can be expected to do well whereas stocks are already discounting the possibility that earnings are unsustainably high and bonds are anticipating Fed tightening. The opposite is true at the bottom of a cycle, when stocks and bonds are forecasting an improved economy, while near term demand for commodities is weak.

Exhibit 13 shows the relative performance of an equal-weighted commodity futures index relative to both the S&P 500 and the Lehman Aggregate. When the line is going up, the commodity futures index is outperforming and when it is declining commodity futures are underperforming. The shaded regions in the chart indicate later expansion phases within the business cycle. Since 1959, the later expansion periods have coincided regularly with commodity futures' out-performance versus both stocks and bonds.

[12] Gorton, Gary and Rouwenhorst, K. Geert. Facts and Fantasies about Commodity Futures. 2004 p22-23.

Exhibit 13: Commodity Future Index Relative Performance

Source: Business cycle data from National Bureau of Economic Research (NBER)

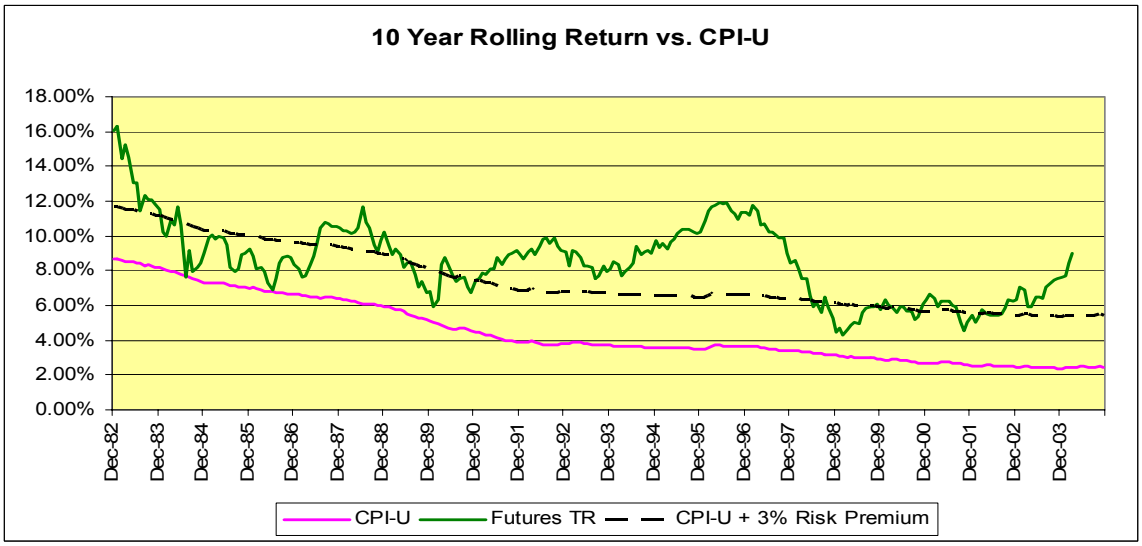
In summary, it appears that commodity futures react in opposite ways to many economic factors compared to the behavior of equities and bonds. This provides a rationale for the observed low correlation with other asset classes.

Portfolio Diversification Effects

Historically, commodity futures would have increased the efficiency of diversified portfolios. A portfolio of 60% stocks (represented by the S&P 500) and 40% bonds (represented by the Lehman Aggregate) returned 9.4% annually with a standard deviation of 9.9% for the July 1959 to March 2003 time period. By comparison, a portfolio of 50% stocks, 30% bonds, and 20% commodity futures would have earned an annual return of 11.2% with a standard deviation of 8.9%. The addition of a 20% allocation to commodity futures improved the risk/return ratio from 0.95 to 1.26.

An efficient frontier can be constructed using forward-looking assumptions derived by Wilshire Associates. The expected return assumption was constructed using an inflation-plus approach based on the historical record and the components of return discussed previously (see page 9). Charting the historical return relative to inflation in Exhibit 14, we can see there was clearly a return premium which exceeded 3.0% per year during this period.

Exhibit 14: Commodity Returns Relative to Inflation



Earlier, it was estimated that rebalancing might add between 1.5% and 2.75% while convenience or roll yield can add approximately 1.5% depending on the rebalancing methodology used. The excess return is assumed to capture the risk premium (if available), real return on the cash collateral, roll yield, and rebalancing yield. Adding an assumed excess return premium of 3.00% to our 2005 long-term inflation estimate of 2.5% produces our expected return of 5.5% for commodity futures. We ignore the effect of expectational variance as it is likely to wash out in the long term, and storage costs as being immaterial to commodity futures index investing. The full matrix of assumptions is detailed in Exhibit 15.

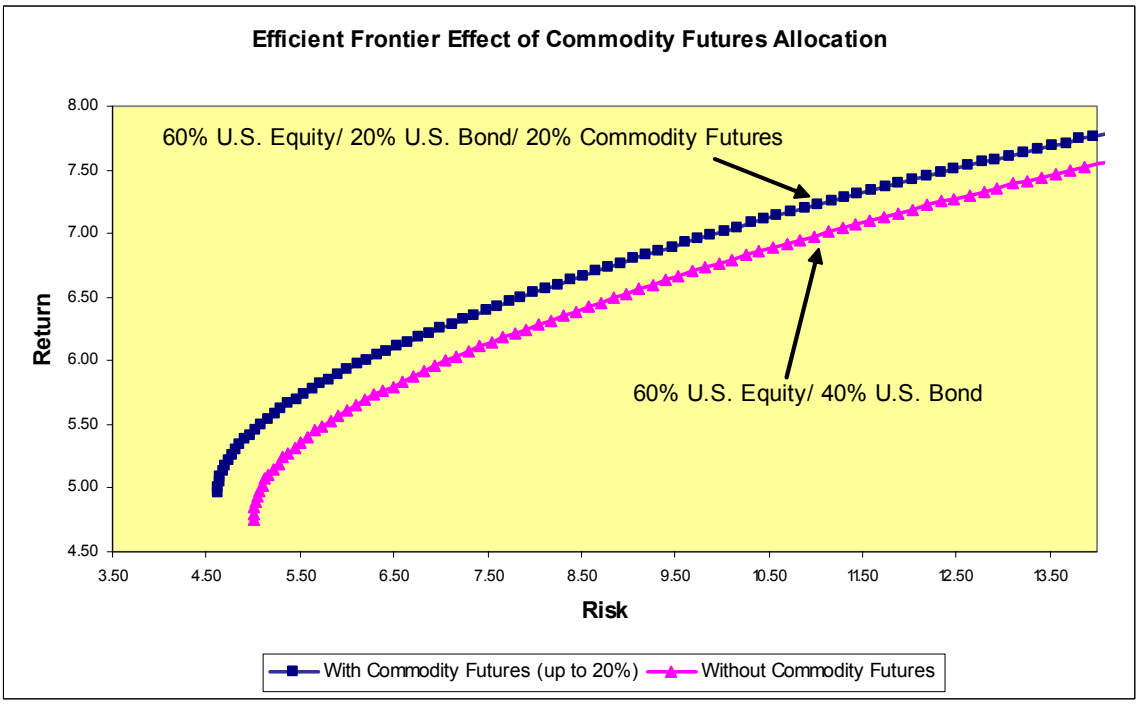
Exhibit 15: Wilshire Associates Asset Assumptions and Correlation Matrix

Asset Class	U.S. Stocks	Commodity Futures	U.S. Bonds	Non-U.S. Stocks	REITs
Return	8.00	5.50	4.75	8.00	7.00
Risk	17.00	12.00	5.00	19.00	16.00
Correlations					
U.S. Stocks	1.00				
Commodity Futures	0.10	1.00			
U.S. Bonds	0.29	0.00	1.00		
Non-U.S. Stocks	0.78	0.04	0.08	1.00	
REITs	0.30	0.25	0.15	0.20	1.00

Source: Wilshire 2005 Asset Allocation: Return and Risk Assumptions. The risk and correlation assumptions are derived from annual historical data for Gorton's equal-weighted commodity futures index.

Exhibit 16 shows the efficient frontier of a simple U.S. stock and bond portfolio with and without a commodity futures' allocation constrained to a maximum of 20%. Commodity futures are represented in all portfolios on the frontier. At a risk level of approximately 11%, for example, commodity futures take part of the fixed income allocation, improving the expected return of the portfolio at the same risk level (7.23% versus 6.98%).

Exhibit 16: Commodity Futures Efficient Frontier Effect



Source: Wilshire Compass

It is also necessary to look at what commodity futures do to portfolios with other asset classes, such as non-U.S. equities and Real Estate Investment Trusts (REITs). REITs in particular are included because as real assets they act as another hedge against inflation.

In order to examine whether commodity futures duplicate the portfolio effects of other real assets such as REITs, four efficient frontiers were calculated for Exhibit 17. REITs

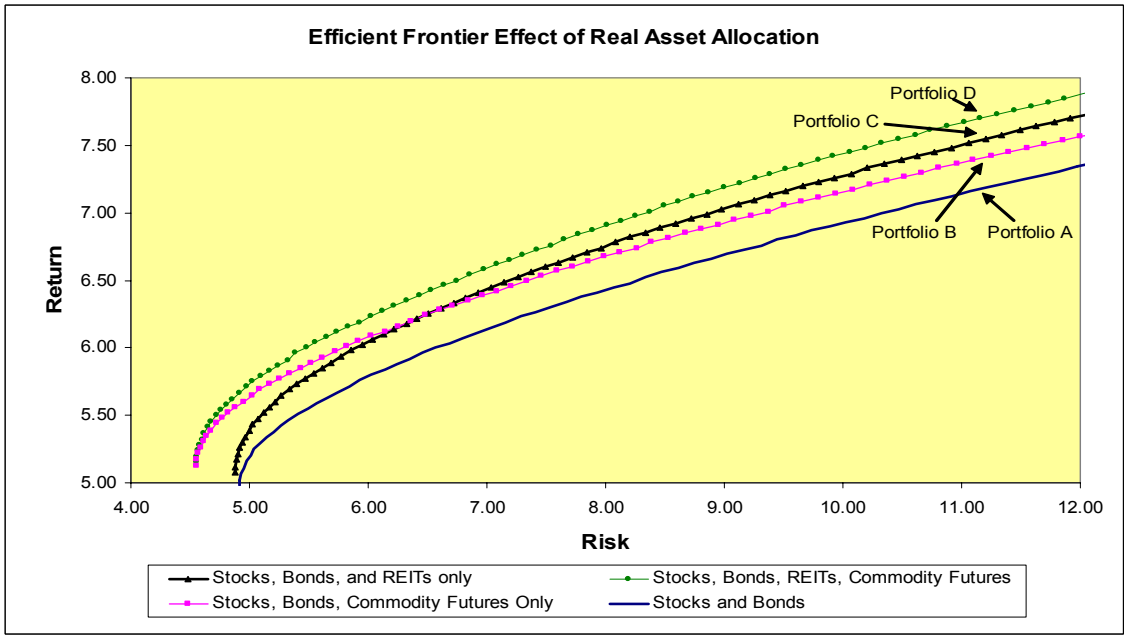
and commodity futures were constrained to a maximum of 20% each. It illustrates that commodity futures combined with REITs produce the most efficient portfolio. The portfolio which includes REITs and excludes commodity futures is less efficient than that which includes only commodity futures but excludes REITs.

One portfolio was highlighted on each efficient frontier at approximately the 11% risk level. This risk level was chosen because it represents the median level of risk found in Wilshire's institutional funding studies. The table in Exhibit 17 displays each portfolio's percentage allocation. Where allowed, real assets hit their constrained maximum of 20%. Portfolio D (both REITs and commodity futures) has the highest expected return at 7.7% versus 7.5% for portfolio C, 7.4% for portfolio B, and 7.2% for portfolio A. At these median risk levels, real assets can increase the expected return of a portfolio by approximately 50 basis points with no increase in expected risk.

Portfolio D reveals a striking reduction in fixed income exposure from a high of 37.6% in portfolio A to 6.7%. Portfolio C has a more equal split between U.S. stocks and bonds and non-U.S. stocks, while portfolio B has a much higher exposure to U.S. equities and lower exposure to U.S. bonds. One explanation for this is that commodity futures provide a portion of the portfolio diversification benefits normally provided by bonds and non-U.S. stocks.

Exhibit 17: Real Assets and the Efficient Frontier

	Portfolio A	Portfolio B	Portfolio C	Portfolio D
U.S. Stocks	34.51	24.72	28.33	27.19
U.S. Bonds	37.60	18.10	24.38	6.72
Non-U.S. Stocks	27.89	27.17	27.29	26.09
Commodity Futures	n.a.	20.00	n.a.	20.00
REITs	n.a.	n.a.	20.00	20.00
Return	7.16	7.39	7.52	7.67
Risk	11.07	11.10	11.06	11.02

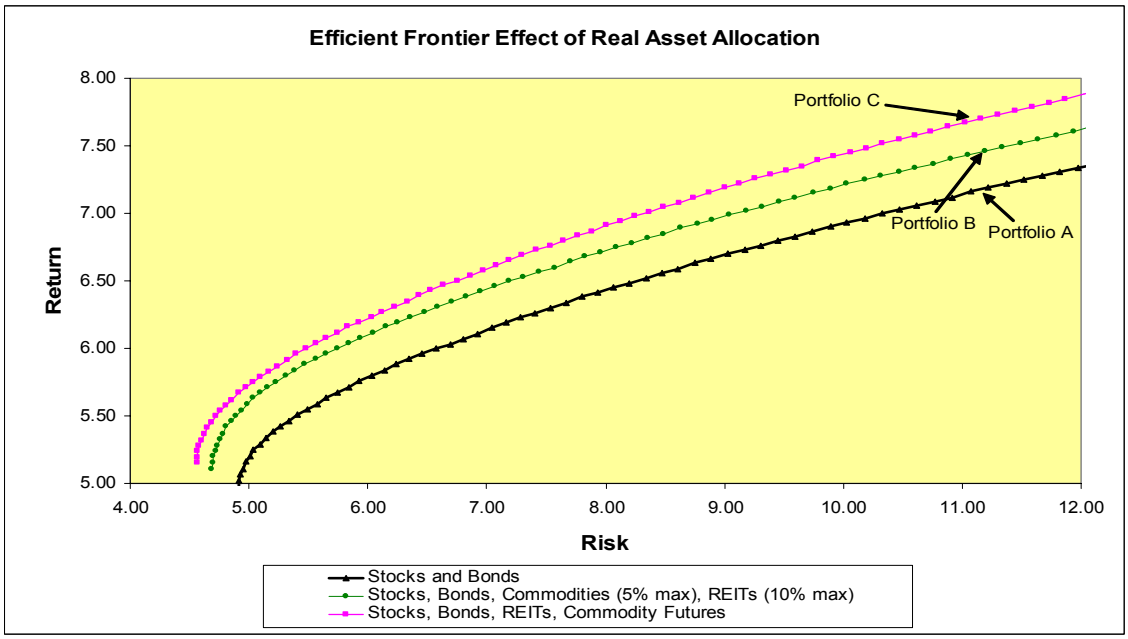


Source: Wilshire Compass

Commodity futures are generally considered risky investments, but Exhibit 17 indicates they can play an important role in reducing overall portfolio risk. As such, does an allocation to commodity futures make sense for all investors? The appropriateness of commodity futures depends specifically on the value each investor places on diversification and risk. In other words, the utility of diversification with commodity futures will be different for each investor, where utility is defined as "a risk-adjusted expected rate of return for the portfolio, where the risk adjustment depends on the level of risk aversion". [13]

In the above example, a 20% real asset constraint was used to demonstrate the potential benefits of including REITS and commodities. However, there are other hurdles institutional investors face which might make a 20% allocation unrealistic. These hurdles can include ERISA guidelines for 'peer-like' behavior, risk aversion to new asset classes, and the relatively short track record of managers running commodity futures strategies with institutional-size money. It is therefore instructive to evaluate the impact that more binding constraints would have on the efficient frontier. A 5% limit on commodity futures and 10% on REITs were chosen because they are representative of allocations seen in institutional portfolios with exposure to these classes. The effects are illustrated in Exhibit 18.

Exhibit 18: Portfolio Effect with Tighter Real Asset Constraints



Source: Wilshire Compass

The return improvement at the 11% risk level is 27 basis points (7.43% vs. 7.16%). At this point on the efficient frontier, both real asset classes have hit their respective constraints. The real asset allocations have replaced approximately 12% of the base portfolio's bond allocation and 3% of its exposure to U.S. equity. This is slightly more

[13] Anson, Mark. Maximizing Utility with Commodity Futures Diversification. 1999

than half of the 51 basis point return improvement under the more liberal 20% constraint discussed earlier.

Conclusion

Over the 1959 to 2004 period, an allocation to commodity futures would have improved the return/risk characteristics of a diversified portfolio. Because they exhibit a low or negative correlation to other assets, particularly U.S. stocks and bonds, commodity futures might be attractive to some institutional investors in building efficient portfolios.

It would appear that an allocation to commodity futures becomes a bet on the term structure of commodity prices going forward, where a greater degree of backwardation enhances roll yield. Investors should understand that future commodity returns will be similar to the historical profile if the premium for providing insurance and convenience (roll yield) are as high in the future as they have been in the past. Further, rebalancing yield is impacted greatly by both index composition and the particular methodology used when rebalancing.

Research has shown, and our findings support, that when looking at a range of investors from risk neutral to highly risk averse, the marginal utility of adding commodity futures to a portfolio is highest for the most risk-averse investors. This is directly related to the low level of correlation we see with respect to commodity futures and other asset classes, where commodity futures act to diminish the overall portfolio's volatility. While commodities may be most attractive to risk-averse investors, it is important to point out that the risk reduction benefit achieved by including commodity futures in a portfolio diminishes as the number of other asset classes increases – especially if restrictive weighting constraints are imposed (i.e. 5% or less). Since risk-averse investors typically maintain well-diversified portfolios, the marginal benefit from adding small allocations to commodities may be insignificant. Therefore, even a risk-averse investor, bound by practical constraints, may not find the incremental risk benefit compelling enough to justify the cost of implementation and maintenance.